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(54) Title: COATING COMPOSITION FOR FIBERS

(57) Abstract

An aqueous coating composition for fibers comprising a thermoplastic polymer powder, a surfactant, a film former polymer, a thickening agent, the balance being water. When coated onto a bundle or strand of glass fibers the coated glass fibers have a final solids content range from about 25 - 30 weight percent and have good flexibility and good compressive strength. Optical fibers are wrapped with coated continuous filaments and then coated with an extruded layer of a thermoplastic resin.

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DESCRIPTION

COATING COMPOSITION FOR FIBERS

TECHNICAL FIELD

This invention relates to impregnant or coating compositions for fibers. The coating compositions of the present invention are especially useful for coating continuous glass strands for use as an overwrap on a fiber optical cable.

BACKGROUND ART

The use of coating compositions on fibers is well known and coating compositions are applied to the surface of the fibers for several reasons. While coating compositions are usually applied to the fibers for the purpose of protecting the fibers during processing subsequent to their formation, such compositions can also have incorporated into their compositions certain components which impart properties which facilitate their usage. Such properties which can be improved include impact strength, compressive strength, strand integrity, flexibility, toughness, and improved adherence between the fiber and a matrix resin.

Such coated fiber are useful in overcoating or wrapping fibers or cables such as, for example, optical cables. Typically, glass fibers are used as an overwrap on a cable or fiber and a thermoplastic resin is solidified on the glass fibers typically by an extruded overcoat. There is no adhesion between the extruded jacket and the braided, helically wound or otherwise applied overwrap. While installing a

cable, grips are attached to the ends of the cable. Due to the poor adhesion between the braided glass overwrap and the extruded coating the grips tend to pull the extruded coating off the cable. The use of the thermoplastic impregnated strands, according to the present invention, prevents this by adhering to the extruded overcoat.

An object of the present invention is to provide a slurry or coating composition for coating glass fibers useful as an overwrap or coating on cables or fibers. It is a further object to provide a coating composition which does not suffer the drawbacks of conventionally coated fibers. In cables currently produced special members are required to prevent buckling. These members are expensive and difficult to use. The thermoplastic impregnated overwrap of the present invention becomes the anti-buckling member after it is fused. It is still a futher object to provide a coating composition which can be totally bound to an extruded protective coating which typically surrounds the cable or fiber.

DISCLOSURE OF INVENTION

The present invention provides an aqueous coating composition useful for glass strands which comprises a thermoplastic resinous dispersion with a film forming polymer.

The coating of the present invention comprises: a thermoplastic resin (preferably polyethylene polymer powder), a surfactant, a film forming polymer (preferably a polyurethane latex polymer), a gel or thickening agent, the balance being water.

According to one preferred use of the present invention, the thermoplastic resin polymer is suspended in the aqueous coating composition in the powdered form when coated on a bundle or strand of fibers or filaments. The coated strand is then wrapped around a cable or core. After the cable or core has been wrapped with the strand, a thermoplastic jacket is extruded over the top of the cable or core. The heat of the molten polymer causes the thermoplastic

polymer powder in the overwrap to melt and flow. The strand can also be preheated prior to the extrusion of the thermoplastic jacket to provide a more complete fusion of the powdered polymer on the overwrap. Upon cooling, the wrapped cable stiffens imparting anti-buckling and stiffness to the cable without adding a separate stiffness member.

The present invention achieves a desirable cable without the need to use self crosslinking resinous materials to provide partial curing or to reduce tackiness of the coating. The present invention further does not require the use of any lubricants.

The aqueous coating composition is especially useful in impregnating continuous glass strands in conventional in-line or off-line coating processes.

These and other aspects and advantages of the present invention will become more clear after consideration is given to the detailed description of the invention which follows.

BEST MODE OF CARRYING OUT INVENTION

The present invention is employable with any glass fiber conventionally utilized for the reinforcement of polymeric resins. The term "glass fibers" as used herein shall mean filaments formed by attenuation of one or more streams of molten glass and to strands formed when such glass fiber filaments are gathered together in forming. The term shall also mean yarns and cords formed by applying and/or twisting a multiplicity of strands together and to woven and non-woven fabrics which are formed of such glass fiber strands, yarns, or cords. Preferably, the coating formulation of the present invention is usable with conventionally available fibers.

The glass fibers used as input to an off-line process can be sized with any conventionally known sizing composition, which is well known to those skilled in the art.

The individual components utilized in the practice of this invention are commercially available and can thus be simply blended

with one another in the preparation of the formulations embodying the features of the present invention.

The invention comprises an aqueous coating composition comprising, approximately, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	5 - 50
surfactant	.5 - 1.5
film former polymer	.5 - 5
a thickening agent	0 - .1
water	balance

Final solids content ranges from 6 to 56 weight percent. The coating composition is applied so as to deposit a dried coating on the fibers corresponding to about 5 to 50 weight percent of the weight of the fibers (LOI).

Preferably the aqueous coating composition comprising, approximately, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	18 - 24
surfactant	.75 - 1.0
film fomer polymer	1 - 3
a thickening agent	0 - .05
water	balance

Final solids content ranges from 20 to 28 weight percent. The coating composition is applied so as to deposit a dried coating on the fibers corresponding to about 24 to 30 weight percent of the weight of the fibers (LOI).

The thermoplastic resin used in the aqueous coating composition may be selected from among conventional thermoplastic resin powders such as, for example, polyesters, polyethylenes, polypropylenes, polyamides and other such conventional polymers available in a powdered form. The particle size of these powdered polymers should be less than 100 microns. One such material is a

polyethylene polymer, Microthene FN 510 R available from USI Chemicals Co. In a preferred embodiment the average particle size of the thermoplastic powder is in the range of about 20 microns or less. It is desired that the resins useful for coating cables (especially optical fibers) have good impact strength, a high modulus of elasticity, good flexibility, and good adhesion to polyethylene and PVC jacketing materials.

The surfactant used in the aqueous coating composition may be a conventional polyether polyol, such as, for example an alkyl aryl polyether alcohol sold by the trade name TRITON X 100 R available from the Rohm & Haas Co.

The dispersible or emulsifiable film forming polymer used in the aqueous coating composition may be a conventional elastomeric polyurethane polymer, such as, for example, RUCO 2010 L available from the RUCO Polymer Corp.

The gel or thickening agent used in the aqueous coating composition may be chosen from a wide range of conventional thickening agents. Drewfloc 270, a polyamide from Drew Chemical Co., has been found to be particularly useful in this application.

The amount of water in the aqueous coating composition is that amount necessary to give a total solids (nonaqueous) content of the aqueous coating composition sufficient to coat the fibers. It is preferred to have the total solids content in the range of about 5 to 50 weight percent, most preferably about 20-28 weight percent.

In the preferred method of formulation of the aqueous coating composition, the surfactant is dissolved in about three fourths of the water forming a main mixture. The thermoplastic resin powder is dispersed into the main mixture. The film foming polymer is then added directly to the resulting main mixture. The thickening agent is dissolved in the remaining water, and thereafter added to the main mixture. The resulting aqueous coating composition has a good consistency, low viscosity, and good stability.

The aqueous coating composition can be applied to continuous strand glass fibers in conventional off-line or in-line processes. In the in-line process the coating is applied as a sizing in the fiber forming operation. In the off-line process a bundle of input strands of glass fibers are pulled through an impregnation bath comprising the aqueous coating composition. The excess coating composition is removed by a stripper die. The resulting wet impregnated or coated bundle is dried in a conventional manner. The coated glass strands may be dried at elevated temperatures in an oven by any of the processes known to those skilled in the art to remove a substantial amount of the water. They may also be dried using a dielectric oven. The drying of the coated glass strand at elevated temperatures does not melt or fuse the thermoplastic resin. The thermoplastic resin is held to the glass fiber by the film forming polymer.

In one process a package is formed by taking up the dry or nearly dry strand on a winder. The package typically has a 5-20 percent by weight residual moisture. Further moisture is then removed by oven drying the package. The oven temperature must be below the melting point of the powdered polymer. The resultant coated strand is plyable and has excellent powder holding capability.

The coated glass fiber is especially useful as an overwrap on any type of cable, or on a fiber optic cable. It is also within the contemplated scope of the present invention that the coated glass fiber can be used in any of a number of reinforcement products. The coated glass fiber is overwrapped on a cable or fiber in a manner known to those skilled in the art.

A glass fiber coated with the aqueous coating composition of the present invention is superior to the conventionally coated or otherwise sized fibers currently available since the coated glass fibers have a desirably higher loading content of thermoplastic resin powder. The glass strand, as coated, is flexible, and is as easily processed as conventionally sized glass fibers.

It is also within the contemplated scope of the present invention that such overwrapped cable have a secondary coating or be further coated with an extrusion of some type of thermoplastic resin such that the thermoplastic resin on the glass fibers not only fuses together with itself, but also is totally bound with the secondary thermoplastic coat. This then provides a coated glass fiber which behaves both as a tension member and as a compression member. As a compression member the glass fiber overwrap on the cable serves as an antibuckling element to prevent damage to the core fiber or cable during processing, installation or in-use curing temperature cycling, especially cold temperature exposures (-40°C).

INDUSTRIAL APPLICABILITY

EXAMPLE 1

An inventive coating composition prepared from the following ingredients:

	Weight percent
thermoplastic polymer powder, Microthene FN 510 from USI Chemicals Co.	25
alkyl aryl polyether alcohol surfactant TRITON X100 from Rohm & Haas	0.89
polyurethane latex film forming polymer RUCO 2010 L from RUCO Polymer Corp.	2.0
poly acrylamide thickening agent, Drewfloc 270 from Drew Chemical Co.	.048
water	balance

Final solids content was about 27 weight percent. The coating composition is applied onto a conventionally sized glass, here an H-15 762 sized glass available from Owens-Corning Fiberglas Corporation

so as to deposit a dried coating on the fibers corresponding to about 26 weight percent of the weight of the fibers (LOI).

Heating the coated fibers to about 150°C causes the adhered thermoplastic resin to flow and fuse, thereby producing a fiber reinforced product especially suitable for use as a coating or overwrap for a cable or fiber. The coated, cured fiber reinforced product when overwrapped on a cable provides a cable having the necessary flexibility and proper degree of stiffness for subsequent processing.

The fiber reinforced optical fiber or cable can have a secondary coating comprising, for example a thermoplastic resinous material which further protects the optical fiber. In a preferred embodiment the thermoplastic resinous material of the secondary coating is essentially the same thermoplastic resinous material used in the aqueous coating composition.

While the invention has been described in detail and with reference to specific embodiment thereof, it will be apparent to one skilled in the art that various changes and modification can be made therein without departing from the spirit and scope thereof.

CLAIMS

1. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	5 - 50
surfactant	.5 - 1.5
film former polymer	.5 - 5
a thickening agent	0 - .1
water	balance

2. The aqueous coating composition of claim 1 having a final solids content ranging from 6 to 56 weight percent.

3. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	18 - 24
surfactant	.75 - 1.0
film former polymer	1 - 3
a thickening agent	0 - .05
water	balance

4. The aqueous coating composition of claim 3 having a final solids content ranging from 20 - 28 weight percent.

5. An aqueous coating and impregnant composition consisting essentially of, on a weight percent basis:

	Weight percent
thermoplastic polymer powder	25
surfactant	0.89
film former polymer	2.0
a thickening agent	.048
water	balance

6. The aqueous coating composition of claim 5 having a final solids content of about 27 weight percent.

7. A plurality of flexible filaments at least a portion of the filament's surface being coated with a residue produced by evaporating water from the aqueous coating composition of claim 1.

8. A filament according to claim 7 wherein the filament is made of glass.

9. A wrapped optical glass fiber comprising a layer of a reinforcing material substantially covering an optical glass fiber, the reinforcing material comprises continuous filaments coated with a residue produced by evaporating water from the aqueous coating composition of claim 1.

10. The optical glass fiber of claim 9 wherein the wrapped fiber has coated thereon an extruded layer of a thermoplastic resin material.

11. The optical glass fiber of claim 10 wherein the extruded layer of thermoplastic resin material is essentially the same thermoplastic resin as the thermoplastic polymer powder in the aqueous coating composition.

12. The aqueous coating composition according to claim 1 wherein the thermoplastic polymer is a polyethylene polymer in the powdered form.

13. The aqueous coating composition according to claim 1 wherein the surfactant is an aryl alkyl polyether alcohol.

14. The aqueous coating composition according to claim 1 wherein the film former polymer is a polyurethane latex polymer.

15. The aqueous coating composition according to claim 1 wherein the thickening agent is a polyacrylamide.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 91/01871

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: C 03 C 25/02; C 08 J 5/08, G 02 B 6/44

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	C 03 C; C 08 J; C 08 L; C 09 D; G 02 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	EP, A1, 0062138 (CHEMISCHE WERKE HÜLS AG) 13 October 1982, see the whole document	1-6,12-15
A	DE, B2, 2024477 (PPG INDUSTRIES, INC.) 26 October 1978, see the whole document	1-8,12-15
A	Patent Abstracts of Japan, Vol 10, No 28, C326, abstract of JP 60-180938, publ 1985-09-14 (FURUKAWA DENKI KOGYO K.K.)	9-11

* Special categories of cited documents:[10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th June 1991	17. 07. 91
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. PEIS M. Peis

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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/US 91/01871

SA 46096

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 30/04/91 The European Patent office is in no way liable for theseparticulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A1- 0062138	13/10/82	DE-A-	3111902	07/10/82
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		FR-A-B-	2044805	26/02/71
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